## Chapter 6: Meat, Fish, Poultry & Eggs

# Protein Connection

Meat, fish, poultry, eggs, beans, nuts, and seeds are all part of the protein foods group. Meat comes from animals such as cows (beef), pigs (pork), lambs, rabbits, deer (venison), and goats. Chicken, turkey, ducks, geese, and other birds we eat are called poultry. Catfish, flounder, salmon, and other types of seafood are all considered fish. In moderation, eggs can also be eaten as a source of protein in a healthy diet. In the United States, chicken eggs are the most popular, but you can eat duck eggs, goose eggs, ostrich eggs, and more! It is important to learn about good sources of meat, fish, poultry, and eggs to maintain a healthy diet and promote growth. In this chapter, students will explore protein by learning about the building blocks of protein (amino acids), the role protein plays in muscle development, and the many health benefits associated with eating lean sources of the protein food group. Students will also explore eggs by learning about the physical parts of an egg, egg foams, and health benefits associated with eating eggs.

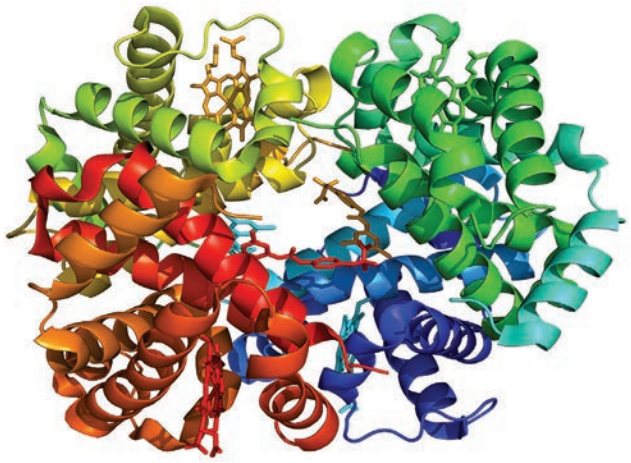
## FOOD EXPLORATION LABS

**Lab I: The Building Blocks**

- Teacher Preparation
- Teacher Lab Answer Key
- Student Lab

**Lab II: Synthesizing Muscles**

- Teacher Preparation
- Teacher Lab Answer Key
- Student Lab



**Lab III: Foam Formulations**

- Teacher Preparation
- Teacher Lab Answer Key
- Student Lab

## INVESTIGATING YOUR HEALTH

**Healthy Proteins**

- Teacher Answer Key

**Try This At Home: Turkey Quesadillas**

**Extraordinary Eggs**

- Teacher Answer Key

**Try This At Home: Fluffy Vegetable Omelet**

## SUPPLEMENTAL MATERIALS

**Teacher Preparation Slides & Video**

**Student Pre-Lab Slides & Videos**

**Amino Acid Color Chart**

# Food Explorations Lab I:
# The Building Blocks

## TEACHER LESSON PREPARATION

### Lesson Focus

Examine dietary sources of protein and generally understand the relationship between protein synthesis and amino acids.

### Lesson Description

Students will use beads, as a representation of amino acids, to construct proteins (polypeptide chains). Students will be asked to identify complete and/or incomplete proteins found in both animal and plant food sources.



### Academic Content Standards

**ELA Common Core Standards for Literacy in Science and Technical Subjects (R-reading, W-writing, SL-speaking and listening, L-language) Grades 6-8**

**R-1** Cite specific textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

**R-3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

**R-4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical content relevant to grade (6-8) text and topics.

**R-7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g. in a flowchart, diagram, model, graph or table).

**R-10** Read and comprehend complex literary and informational texts independently and proficiently.

**W-2** Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

**SL-1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade (6-8) topics, texts, and issues, building on others' ideas and expressing their own clearly.

**L-1** Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

## Next Generation Science Standards

### Performance Expectations

**MS-LS1-3** Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

**MS-LS1-7** Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

### Disciplinary Core Ideas

**LS1.A** Structure and Function: In multicellular organisms the body is a system of multiple interacting sub-systems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.

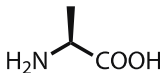
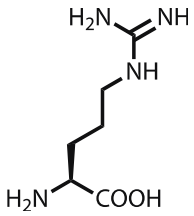
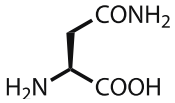
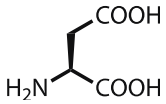
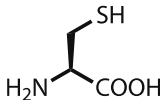
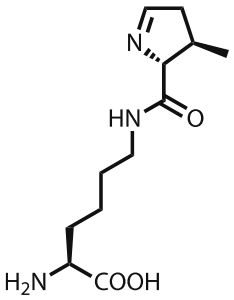
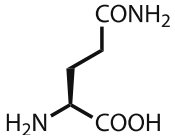
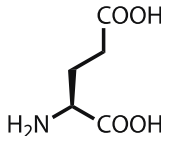
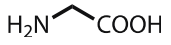
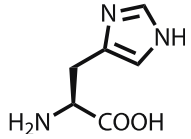
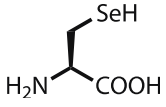
**LS1.C** Organization of Matter and Energy Flow in an Organism: Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, support growth, or release energy.

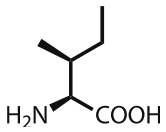
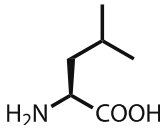
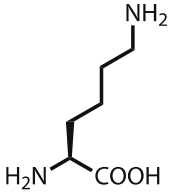
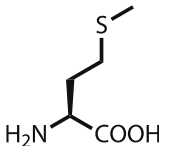
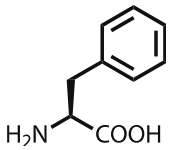
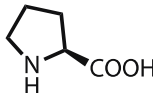
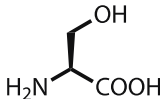
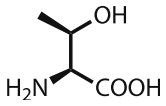
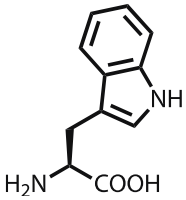
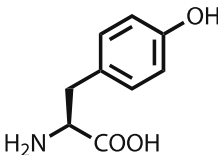
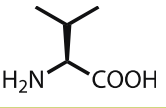
### Science and Engineering Practices

**Developing and Using Models:** Develop a model to describe unobservable mechanisms.

## Background Information

Proteins are created through a process called **protein synthesis**. Protein synthesis occurs inside of a cell. **Transcription** and **translation** are the two steps that occur during protein synthesis. Transcription is the first step in the process, where **DNA** is copied to create a **RNA** molecule. DNA and RNA are the two types of nucleic acids found in our cells. Translation is the second step in protein synthesis. During this step, RNA is translated into an amino acid sequence. During translation, **elongation** occurs. This step adds amino acids through the formation of peptide bonds. Amino acids are continually added until a complete protein is created.

| Amino Acid | Classification | Abbreviation | Structure |
|---|---|---|---|
| **Alanine** | Nonessential | Ala |  |
| **Arginine** | Nonessential | Arg |  |
| **Asparagine** | Nonessential | Asn |  |
| **Asparatic Acid** | Nonessential | Asp |  |
| **Cysteine** | Nonessential | Cys |  |
| **Pyrrolysine** | Nonessential | Pyl |  |
| **Glutamine** | Nonessential | Gln |  |
| **Glutamic acid** | Nonessential | Glu |  |
| **Glycine** | Nonessential | Gly |  |
| **Histidine** | Essential | His |  |
| **Selenocysteine** | Nonessential | Se-CYs |  |

| | | | |
|---|---|---|---|
| **Isoleucine** | Essential | Ile |  |
| **Leucine** | Essential | Leu |  |
| **Lysine** | Essential | Lys |  |
| **Methionine** | Essential | Met |  |
| **Phenylalanine** | Essential | Phe |  |
| **Proline** | Nonessential | Pro |  |
| **Serine** | Nonessential | Ser |  |
| **Threonine** | Essential | Thr |  |
| **Tryptophan** | Essential | Trp |  |
| **Tyrosine** | Nonessential | Tyr |  |
| **Valine** | Essential | Val |  |

Protein can be found in both plant and animal foods. Beans, nuts, grains, and seeds are all plant sources of protein. Animal sources of protein include meat, poultry, fish, eggs, and dairy. Animal foods contain all nine **essential amino acids** our bodies needs. Essential amino acids cannot be made by our bodies and must be consumed in our diet. They are also considered limiting amino acids because we need all of them for protein synthesis to function at maximum capacity. Without adequate amounts of each of these amino acids, our bodies cannot synthesize enough protein to maintain our muscle mass, bones, blood, and organs. For example, if we do not consume tryptophan, which is found in corn and animal foods, protein synthesis will be limited. Unlike animal sources, plant sources of protein can only provide us with some of the essential amino acids. These foods are called **incomplete proteins**. We must consume two or more of certain incomplete proteins to make complementary proteins. When consumed together, **complementary proteins** provide our bodies with the essential amino acids we would get from complete proteins. We have to be careful because only the right combinations will provide the necessary amino acids. For example, we would need to combine legumes with grains, nuts, or seeds to make complementary proteins.



### Protein Content of Common Foods:

| Protein Source | Serving | Protein Amount | Limiting Amino Acid |
|---|---|---|---|
| **Meat:**<br>Beef<br>Chicken (boneless)<br>Pork (boneless) | 4 ounces | <br>28 grams<br>30 grams<br>29 grams | None |
| **Soy:**<br>Soy Bean<br>Soy Milk<br>Tofu | ½ cup | <br>14 grams<br>4 grams<br>20 grams | Controversial – many sources tout soy as a complete protein, however others state it is missing Methionine. |
| Peanuts | ½ cup | 19 grams | Methionine and Tryptophan |
| White Rice (cooked) | ½ cup | 5 grams | Lysine |
| Beans (cooked) | ½ cup | 7-10 grams | Methionine |
| **Toast:**<br>White<br>Wheat | 1 slice | <br>3 grams<br>4 grams | Lysine and Isoleucine |

## Materials

### Teacher Materials

**NOTE: Teacher material list is based on 6 groups of 4-5 students (24-30 students total).**

24 craft pipe cleaners
24 plastic sandwich bags
1 black permanent marker
1056 colored pony beads (48 each of 22 different colors)
48 clear pony beads

## Student Materials

**NOTE: Student material list is based on 1 group of 4-5 students. Refer to the FoodMASTER Middle "Equipment and Material Lists by Chapter" for whole class estimates (24-30 students divided into 6 groups) on perishable and nonperishable materials.**

4 Craft Pipe Cleaners
1 sandwich bag labeled "meat" containing 44 beads total (2 of each color of the 22 colors, no clear)
1 sandwich bag labeled "rice and beans" containing 44 beads total (2 of each color, no clear)
1 sandwich bag labeled "peanut" containing 44 beads total (2 of each color except for those assigned to Methionine and Tryptophan, and 4 clear beads)
1 sandwich bag labeled "toast" containing 44 beads total (2 of each color except for those assigned to Lysine and Isoleucine, and 4 clear beads)

## Teacher Pre-Lab Preparation

1. Review teacher background information, teacher preparation slides, student pre-lab slides/videos, student introduction, suggested instructional plan, and the student *Food Exploration* lab investigation procedures.

2. Assign one bead or bead combination to each amino acid. Students will need to be given the key prior to beginning their lab. You may choose to provide each student group with a visual key using the Amino Acid Color Chart. The chart lists each amino acid name and abbreviation. Place corresponding beads on each amino acid.

3. For each group, prepare four plastic bags containing a mixture series of "amino acids" for building each protein. Each bag should be labeled "Meat", "Peanut", "White Rice and Beans", or "Toast" and contain 2 of each different colored "amino acids" (40 beads total) with the below exceptions:

   - Meat Amino Acids: No missing amino acid
   - Peanut Amino Acids: Missing Methionine and Tryptophan (replace both with clear beads)
   - Toast Amino Acids: Missing Lysine and Isoleucine (replace both with clear beads)
   - White Rice and Beans Amino Acids: No missing amino acid

   **NOTE: See student materials above: 8 beads will be left over representing the limiting amino acids from toast and peanuts**

**TIMESAVER:** Assign bead colors to each amino acid ahead of time. Consider using the supplemental *Amino Acid Color Chart* found on page 144 in the Teacher Ediiton as a template by attaching (e.g. gluing) the beads directly to the chart. Provide one chart to each student group.

Direct each group member to construct one protein molecule or assign students a strand to construct for homework.

**TIP: If materials are not available, use the amino acid color chart (no colors) for the symbols. Copy the amino acid color chart as is for meat, and rice and beans. For peanuts, white-out the abbreviations Met and Trp and copy, and, for toast, white out Lys and Ile and copy. Students can then cut out the amino acid symbols and place them in the correct order. The amino acid symbols may be glued to another sheet of paper if desired.**

## Suggested Instructional Plan

1. Review scientific vocabulary and knowledge prerequisites:

| | | |
|---|---|---|
| **Protein** | **Limiting Amino Acids** | **Synthesis** |
| **Amino Acids** | **Complementary Proteins** | |

2. Distribute Materials:

It is recommended that materials are organized into stations for easier distribution. Materials are recommended based on the amount needed for 1 class of 30 students. Students should be arranged in small groups of 4-5.

**Each group should receive:**

- Student Lab Investigation Worksheets (1 per student)
- Student Materials

3. Ask students to read *Protein Connection* and complete the focus questions for this lab investigation

4. Launch the lab by asking students to predict which foods are considered complete proteins.

**TIMESAVER:** Instruct students to work individually within their groups. Each student can construct one of the four proteins to speed up the process.

5. Allow students to construct their protein models. Show students the lab video demonstration, *Part I: The Building Blocks Demonstration Video* to show an example of how to construct a protein model.

6. Students should find two of the food sources (bag of beads) are missing one or two amino acids (colored bead). Remind students to use a clear bead to represent any missing amino acid.

   a. *Meat:* Animals proteins are complete.

   b. *Peanuts:* Plant-based proteins are not complete, unless paired with another plant-based food that contains the missing amino acid. Legumes are missing the amino acids methionine and tryptophan.

   c. *Toast:* Plant-based proteins are not complete. Grain sources are typically missing isoleucine and lysine. Lysine is particularly low in grain sources that have been exposed heated, such as toast.

d. *White* Rice and Beans: Plant-based proteins are not complete. Beans are typically missing methionine and tryptophan. On the other hand, grain sources are missing isoleucine and lysine. When the two are eaten together, the amino acids within each food combine to create a complete amino acid profile.

7. Allow students to work in small groups on the Student Lab Investigation worksheet to further explore the topic and respond to lab questions.

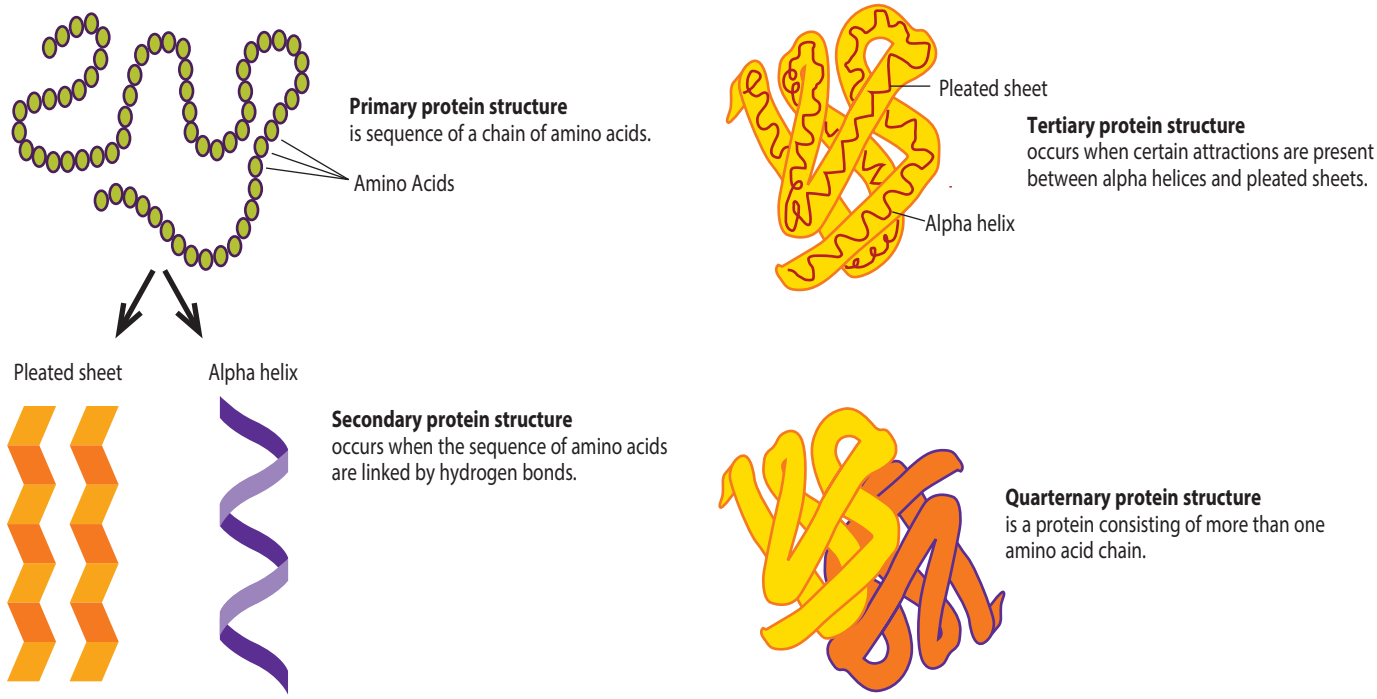
8. Consider allowing students to keep their protein strand. Students can wear the strand around their wrist like a bracelet and discuss what they learned about protein and sources of proteins with others.

9. Follow-up with a class discussion about different sources of protein in the diet and their relationship to protein synthesis. Follow-up this lesson with the *Investigating Your Health* investigation. See *Teacher Bites* for ideas on how to further extend this lesson.

## Teacher Bites: Lesson Extension

- Build a model of an amino acid showing each molecule (C, O, H and N) and how they are bonded together (single vs. double). You can use play-doh and toothpicks or straws to make amino acid models. Select a different color play-doh for each atom (C, O, H, and N). Connect each of them based on amino acid structure using one or two toothpicks/straws depending on the type of bond (single or double).

- Explore protein structures using the protein strands created with beads and pipe cleaners.



# Food Explorations Lab II:
# Synthesizing Muscles

## TEACHER LESSON PREPARATION

### Lesson Focus

Understand the role proteins play in muscle development

### Lesson Description

Students may construct or use previously constructed models of arm muscles and compare the model's muscle tension to individuals who have varying dietary protein intake.

### Academic Content Standards

**ELA Common Core Standards for Literacy in Science and Technical Subjects (R-reading, W-writing, SL-speaking and listening, L-language) Grades 6-8**

**R-1** Cite specific textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

**R-3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

**R-4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical content relevant to grade (6-8) text and topics.

**R-7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g. in a flowchart, diagram, model, graph or table).

**R-10** Read and comprehend complex literary and informational texts independently and proficiently.

**W-2** Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

**SL-1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade (6-8) topics, texts, and issues, building on others' ideas and expressing their own clearly.

**L-1** Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

# Next Generation Science Standards

## Performance Expectations

**MS-LS1-3** Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

**MS-LS1-7** Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

## Disciplinary Core Ideas

**LS1.A** Structure and Function: In multicellular organisms the body is a system of multiple interacting sub-systems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions.

**LS1.C** Organization of Matter and Energy Flow in an Organism: Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, support growth, or release energy.

## Science and Engineering Practices

**Developing and Using Models:** Develop a model to describe unobservable mechanisms.

# Background Information

See Teacher Lesson Preparation under *Food Lab Explorations Part I* and the student background *Protein Connection*.

# Materials

## Teacher Materials

**NOTE: Teacher material list is based on 6 groups of 4-5 students (24-30 students total).**

3 - 50 count bags of rubber bands 7″x1/8″
6 – ½″ foam tubular insulation
1-2 – 5′ single cord channels
24 – 8″ cable ties
48 – 4″ cable ties
1 pair scissors
1 measuring tape
1 knife

## Student Materials

**NOTE: Student material list is based on 1 group of 4-5 students. Refer to the FoodMASTER Middle "Equipment and Material Lists by Chapter" for whole class estimates (24-30 students divided into 6 groups) on perishable and nonperishable materials.**

1 arm with 3 rubber bands
1 arm with 5 rubber bands
1 arm with 6 rubber bands
1 arm with 10 rubber bands
Calculators

## Teacher Pre-Lab Preparation

1. Review teacher background information, teacher preparation slides, student pre-lab slides/videos, student introduction, suggested instructional plan, and the student *Food Exploration* lab investigation procedures.

2. Construct four arms for each group (see directions). Each arm will be made with a different number of rubber bands (3, 5, 6, and 10).

   **NOTE: More or fewer sets of arms may be needed depending on the number of students and if the student groups can share arms. A minimum of 1 set for every 2 students is recommended.**

3. **OPTION:** If there is sufficient time and materials available, the teacher may elect to have students make the arms; however, it is recommended that all cutting be done by the teacher (See directions steps 1-3).

### Directions for Making Arms

*(Also see Teacher Preparation Slides & Video)*

**NOTE: All items needed from this lab can be purchased at a home improvement store.**

1. Cut foam tubular insulation into 18" pieces in length.

2. At the center point of each 18" piece with the slit side of the foam up, cut about a 90º wedge from the top half of the foam. This will be the elbow.

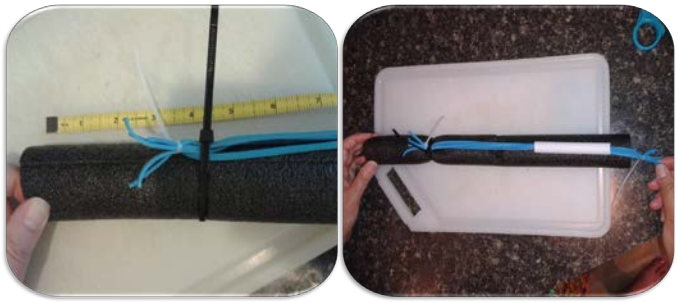
3. Cut the single cord channel into 3 to 4" segments. Typically a cord channel is used to secure cords/wires from one location to the next.

4. Remove the adhesive covering from the cord channel and attach each one about 1″ from one end of each tube on the slit side of each tube (same side as wedge).

5. Make rubber band bundles by cutting one end of the band so that they are 14″ long. To make the 3-band bundle, take 3 pieces, line them up so the ends are even, and attach a 4″ cable tie about 1″ from one end loop of the rubber bands, and then pull tight. Do the same at the other end. Make three 3-band bundles and three 5-band bundles. Larger bundles are difficult to insert into the cord channel.

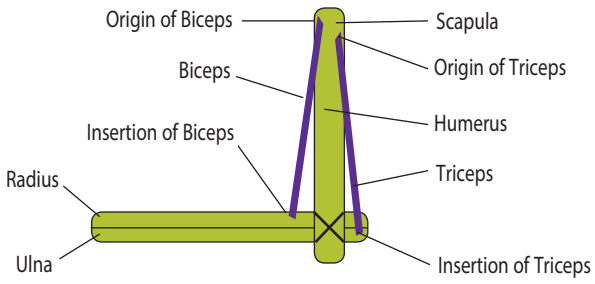
6. Insert the correct bundles into the cord channel for each arm (one with one 3-band bundle, one with one 5-band bundle, one with two 3-band bundles, and one with two 5-band bundles).

7. Lay out the bundles across the foam tubes and use 8″ cable ties to attach them to the tube. Be sure to pull the cable tie tight so that the rubber bands will not pull out.



8. The arm will bend upward when the rubber bands are pulled at the cord channel end of the arm. Tape can be used to cover the slit in the cord channel if the rubber bands tend to slide out.

**Simple Model of Human Arm**




## Suggested Instructional Plan

1. Review scientific vocabulary and knowledge prerequisites:

**Protein** **Synthesis** **Amino Acids**

2. Distribute Materials:

It is recommended that materials are organized into stations for easier distribution. Materials are recommended based on the amount needed for 1 class of 30 students. Students should be arranged in small groups of 4-5.

**Each group should receive:**

- Student Lab Investigation Worksheets (1 per student)
- Student Materials

3. If applicable, ask students to read *Protein Connection* and complete the focus questions for this lab investigation.

4. Launch the lab by asking students to predict which factors (i.e. exercise, adequate protein intake, low protein intake, or high protein intake) promote muscle synthesis.

5. Have students read the case studies and determine which arm matches each case.

6. Students should find one case study consumes adequate protein, one inadequate protein, and two large amounts of protein in the diet.

   a. *Case Study A:* Johnny consumes adequate protein in his diet and participates in regular exercise.

   b. *Case Study B:* Sandra consumes inadequate dietary protein. Despite participating in regular exercise, her lack of dietary protein limits her ability to synthesize new muscle.

   c. *Case Study C:* Mary is an athlete and eats a large amount of protein. The protein in her diet is utilized to repair and synthesize new muscle.

   d. *Case Study D:* Michael consumes a large amount of protein, but does not exercise. This additional protein will not be used for protein synthesis (muscle development). Instead, the additional protein will be oxidized, or most likely, stored as fat in the body.

7. Due to the nature of the rubber band arms, remind students that muscles do not expand. Muscles move by contracting and relaxing. When muscles contract, the muscle fibers slide together to form a stack. When muscle fibers relax, they slide apart, allowing the muscle to become thinner and longer.

8. Allow students to work in small groups on the Student Lab Investigation worksheet to further explore the topic and respond to lab questions.

9. Follow-up with a class discussion about the relationship between protein in the diet, exercise, and muscle development. Follow-up this lesson with the *Investigating Your Health* investigation. See *Teacher Bites* for ideas on how to further extend this lesson.

## Teacher Bites: Lesson Extension

- Build a diorama demonstrating the mechanics of muscle and the skeletal system.

# Food Explorations Lab III:
# Foam Formulations

## TEACHER LESSON PREPARATION

### Lesson Focus

Understand the anatomy of eggs and concept of forming colloidal dispersions called foams.

### Lesson Description

This lesson is divided into two parts. In Part A, students will investigate the anatomy of an egg and will create a foam by whisking the egg whites. They will also see the effect of whisking time on the foam. In Part B, the class will investigate the effect of different substances on the foams stability.

### Academic Content Standards

**ELA Common Core Standards for Literacy in Science and Technical Subjects (R-reading, W-writing, SL-speaking and listening, L-language) Grades 6-8**

**R-1** Cite specific textural evidence to support analysis of science and technical texts.

**R-3** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

**R-4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical content relevant to grade (6-8) text and topics.

**R-7** Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g. in a flowchart, diagram, model, graph or table.

**R-10** Read and comprehend complex science/technical texts independently and proficiently.

**W-2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

**W-9** Draw evidence from informational texts to support analysis, reflection, and research

**SL-1** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade (6-8) topics, texts, and issues, building on others' ideas and expressing their own clearly.

**L-1** Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.

# Next Generation Science Standards

## Performance Expectations

**MS-PS1-2** Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

## Disciplinary Core Ideas

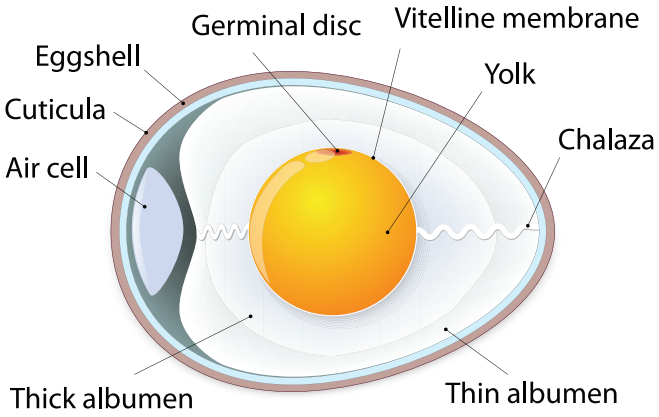
**PS1.A** Structure and Properties of Matter: Each substance has characteristic physical and chemical properties that can be used to identify it.

## Science and Engineering Practices

**Analyzing and Interpreting Data:** Analyze and interpret data to determine similarities and differences in the findings.

# Background Information

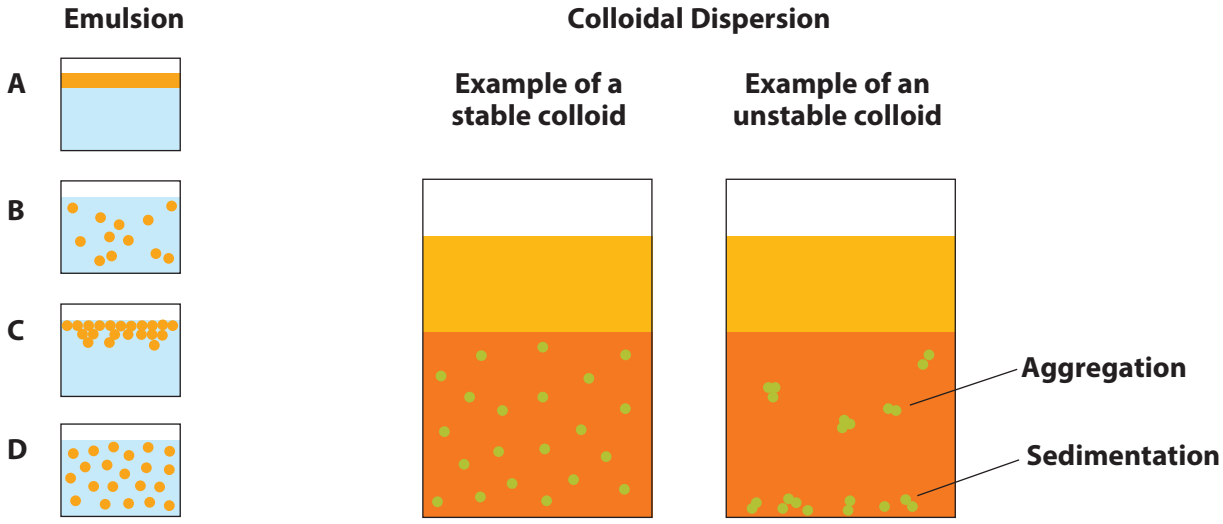
Eggs have an outer shell, a yellow **yolk** (vitelline), a clear white (**albumen**), and an air cell. The yolk contains most of the nutrients of the egg. The albumen contains mostly protein. On the side of the egg yolk, there is a small, white disk. This disk is referred to as the germinal disc. The twisted, cord-like structures on opposite sides of the yolk are called the chalazae [kuh-ley-zee]. Their function is to hold the yolk in the center of the egg white. An air cell forms after the egg is laid, as the contents cool and contract.




While chicken eggs are a source of protein in our diets, the egg's purpose is actually reproduction. In a way, you can think of an egg like a single large cell, even though the yolk and white are molecularly multi-celled. The cell's nucleus is located in the disc, and it is where cell division occurs in a fertilized egg. Embryonic development occurs here, making the germinal disc the ovum. The yolk and the albumen contain the nutrients for the developing embryo. The air cell is used to provide air to the chick from inside the egg. Keep in mind that the eggs we buy in the grocery store are not fertilized eggs and will never produce a chick.

Non-fertilized eggs are used for a variety of purposes in cooking. The egg's emulsifying ability make it very useful in food preparation. The **lipoproteins** found in the yolk help form emulsions because some attract water and others repel water, which will allow oil and water to mix. The figure on the next page provides a visual of how oil and water do not mix naturally. The first picture (A) represents the separation of oil (dark gray) and water (light gray), while the last picture (D) represents a well-mixed solution. Liquids can also be mixed with gas to create a colloidal dispersion where the gas particles are evenly dispersed in the liquid.

When egg whites are beaten, a colloidal dispersion forms foam. The beating motion forces air (gas) into the egg white (liquid). When making foams, the addition of certain substances will change the characteristics of the egg foam. If sugar is added to egg white foam, it will increase beating time; however, a more stable foam will be produced due to a delay in the breakdown of protein. Acids, like cream of tartar, will decrease the pH and make the foam more stable. Salt will decrease stability, but enhance flavor. Fat will inhibit foam formation. Therefore, precautions should be taken to make sure your egg whites have not been contaminated with fat (e.g. oil or egg yolk). Acid and sugar are commonly used to make many egg-based recipes. For example, sugar is added when making meringues.




A. Two immiscible liquids, not emulsified

B. An emulsion of "II" dispersed in "I"

C. An unstable emulsion progressively separates

D. The surfactant positions itself on the interfaces between "II" and "I", emulsion stabilized



## Materials

### Teacher Materials

**NOTE: Teacher material list is based on 6 groups of 4-5 students (24-30 students total).**

**Part A**

6 eggs

paper towels

**Part B**

1 cup of egg whites

¼ tsp. salt

¼ tsp. vegetable oil (or any type)

12 clear plastic cups for treatments (4 ounce or smaller)

measuring spoons (if treatments pre-measured)

1 tsp. sugar

¼ Tbsp. acid (cream of tartar or lemon juice)

paper towels

**NOTE: Because there are 4 different treatments, multiple groups may be using the same treatment. Amounts above reflect what is needed for 1 group – adjust according. The plastic cups may be used to provide groups with their treatment.**

## Student Materials

**NOTE: Student material list is based on 1 group of 4-5 students. Refer to the FoodMASTER Middle "Equipment and Material Lists by Chapter" for whole class estimates (24-30 students divided into 6 groups) on perishable and nonperishable materials.**

**Part A**

1 egg
2 small glass or steel bowls
1 paper plate
1 egg separator
1 whisk
1 kitchen timer or stopwatch

**Part B**

assigned treatment
1/8 cup (2 tablespoons) of egg white
1 rubber spatula
1 ruler
1 10- or 25-mL graduated cylinder
measuring spoons (teaspoon, ½ teaspoon, ¼ teaspoon, ½ tablespoon)
1 funnel
1 small glass or steel bowl
1 whisk or electric mixer
1 kitchen timer or stopwatch

## Teacher Pre-Lab Preparation

1. Review teacher background information, teacher preparation slides, student pre-lab slides/videos, student introduction, suggested instructional plan, and the student *Food Exploration* lab investigation procedures.

2. Prepare materials for each group.

3. For Part B, assign each student group a treatment (sugar, acid, fat, or salt).

4. Prepare materials for treatment assignments. You are encouraged to allow students to measure out their own treatments; but if time is a concern, pre-measuring treatments is recommended.

   **Egg White: 6 clear cups containing 1/8 cup of egg white**

   *Treatment A:* 2 clear cups containing 1 teaspoon sugar

   *Treatment B:* 2 clear cups containing ¼ tablespoon (1/2 tsp. + 1/4 tsp.) acid (cream of tartar or lemon juice)

   *Treatment C:* 2 clear cups containing ¼ teaspoon fat (oil – any type)

   *Treatment D:* 2 clear cups containing ¼ teaspoon salt

5. Separate the egg yolk and white ahead of time if you do not want students to participate in this portion of the lab. For Part B, you may also choose to use a carton of egg whites versus separating raw eggs.

6. Frequent hand washing is an important emphasis in egg lab activities. Students should be discouraged from tasting raw egg (including foams). When practicing appropriate food safety procedures, eggs can be safely handled in the classroom.

**TIMESAVER:** If feasible, students should use an electric mixer versus a whisk, particularly if time is a concern.

**IMPORTANT NOTE: If you choose to separate the egg yolk and white to obtain the egg white needed for Part B, make sure the egg yolk does not contaminate the egg whites. Additionally, make sure no oils contaminate the bowl or beater. These factors can negatively impact the formation of egg whites during the investigation.**

## Suggested Instructional Plan

1. Review scientific vocabulary and knowledge prerequisites:

**Foams** **Colloidal Dispersions** **Solutions**

2. Consider having your students research foams and colloidal dispersions prior to beginning the lab investigation.

3. Before beginning the lab investigation:

   a. Require students to wash their hands.

   b. For food safety reasons, DO NOT allow students to taste any egg products. When practicing appropriate food safety procedures, eggs can be safely handled in the classroom.

   c. Emphasize the importance of practicing good food safety behaviors by not consuming substances used as part of the lab investigation.

4. Ask students to read *Foaming Bonds* and complete the focus questions for this lab investigation.

5. Distribute Materials:

   It is recommended that materials are organized into stations for easier distribution. Materials are recommended based on the amount needed for 1 class of 30 students. Students should be arranged in small groups of 4-5.

   **Each group should receive:**

   - Student Lab Investigation Worksheets (1 per student)
   - Part A Student Lab Materials

6. Launch **Part A** of the lab by asking students to make a prediction about actions that can be taken to increase the stability (firmness) of egg white foams.

7. Show students the provided video lab demonstration *(Lab III: Foam Formulations Part A Video)*. The video will demonstrate how to properly crack an egg and separate the white from the yolk and the four stages of peak formation in egg whites. Photographs for each stage are also included in the *Teacher Preparation Slides* and *Student Pre-Lab Slides*.

8. In Part A of this lab investigation, students will observe the parts of an egg and the different stages of foam formation in egg whites. This part of the lab will provide foundation for Part B, when students observe how various substances impact foam formation.

9. Allow students to work in small groups on the Student Lab Investigation worksheet to further explore the topic and respond to lab questions.

10. After completing initial observations and conclusions, students should be prepared to begin Part B.

11. Distribute Materials:

    It is recommended that materials are organized into stations for easier distribution. Materials are recommended based on the amount needed for 1 class of 30 students. Students should be arranged in small groups of 4-5.

    **Each group should receive:**

    - Student Lab Investigation Worksheets (1 per student)
    - Part B Student Lab Materials

12. Launch **Part B** of the lab by providing students with their assigned treatments. Students will predict what will happen to their egg white's stability when their assigned treatment is added. Photographs demonstrating each treatment (before and after) are included in the *Teacher Preparation Slides* and *Student Pre-Lab Slides*.

    a. *Sugar:* When sugar is added to an egg white at the foamy stage it will create a smooth, stable foam. However, the addition of the sugar will delay denaturation of the egg proteins, increasing the beating time required to reach peak foam stage. Sugar is best added to egg whites in the beginning stages of foam formation.

    b. *Acid:* An egg white's natural pH is basic (7.6 to 7.9). When an acid is added, it will decrease the pH of the egg white. Proteins are less stable and more prone to denaturation at lower pH levels. The denaturation of the egg proteins will improve foam formation; however, adding too much acid (pH less than 4.6) will result in delayed foam formation and decreased stability.

    c. *Fat:* Fat will cause a decrease in the stability of egg white foam. Even a small amount will interfere with formation of a foam. For this reason, the egg yolk cannot mix with egg white when making foams. The fat in the egg yolk will prevent the formation of foam.

d. *Salt:* Salt is often added to egg foams because it adds flavor. The addition of salt will decrease the stability of egg white foams if eggs are only beaten for a short time. If eggs are beaten for an extended amount of time, salt will not have an effect of the stability of the foam.

13. Demonstrate how to measure the foam height or show students the *Lab III: Foam Formulations Part B Video*.

14. Allow students to work in small groups on the Student Lab Investigation worksheet to further explore the topic and respond to lab questions.

15. Follow-up with a class discussion about the impact of various substances on proteins. Follow-up this lesson with the *Investigating Your Health* investigation. See *Teacher Bites* for ideas on how to further extend this lesson.

## Teacher Bites: Lesson Extension

- Use egg white to make meringue cookies.
- Use other types of foods to investigate emulsions (i.e. milk).
- Investigate the impact of temperature (cold versus warm) on the formation of foams.
- Investigate emulsifiers (see Chapter 10: Fats *Lab Investigation II Examining Emulsions*).

# Investigating Your Health:
# Healthy Proteins

**STUDENT HEALTH INVESTIGATION**

## Lesson Focus

Explore healthy sources of protein. Students will compare the nutritional qualities of three types of meat by examining their Nutrition Facts Labels.

## Lesson Description

Students will compare and contrast the Nutrition Fact Labels for three different ground meats to determine healthy sources of protein.



## Academic Content Standards

**ELA Common Core Standards for Literacy in Science and Technical Subjects (R-reading, W-writing, SL-speaking and listening, L-language) Grades 6-8**

**R-1** Cite specific textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

**R-4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical content relevant to grade (6-8) text and topics.

**R-10** Read and comprehend science/technical texts in the grades 6-8 text.

**W-2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

**W-7** Conduct short research projects to answer a question (including a self-generated question) drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

**W-9** Draw evidence from informational texts to support analysis, reflection, and research.

## Next Generation Science Standards

### Performance Expectations

**MS-LS1-7** Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

## Disciplinary Core Idea

**LS1.C** Organization for Matter and Energy Flow in Organisms: Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, support growth, or release energy.

## Science and Engineering Practices

**Analyzing and Interpreting Data:** Analyze and interpret data to determine similarities and differences in the findings.

# Suggested Instructional Plan

1. Review Scientific Vocabulary and Knowledge Prerequisites:

   **Protein**

2. Instruct students to research various sources of lean protein prior to beginning the investigation.

3. Using the provided student background or information learned from researching protein sources, students should examine the food labels for three types of ground meat (i.e. 73% ground beef, 93% lean ground beef, and 93% lean ground turkey).

4. Students can find food labels in the grocery store, on USDA's nutrient database (http://ndb.nal.usda.gov/ndb/search/list), or use the labels provided.

5. If you choose to use the provided protein food labels, see the Teacher Edition workbook for answers to the *Investigating Your Health* lab questions. Answers to questions based on other food labels will vary.

6. If completed in-class, allow students to work in small groups on the Investigation worksheet to further explore the topic and respond to questions.

7. Follow-up with a class discussion about student findings related to the health benefits of consuming lean sources of protein.

# Protein Food Labels

## 93% Lean Ground Beef

**Nutrition Facts**

| | |
|---|---|
| **Serving Size** | **4 oz** |
| **Calories** | **170** |
| **Total Fat** | **8g** |
| **Sodium** | **70mg** |
| **Total Carbohydrates** | **0g** |
| Dietary Fiber | **0g** |
| Sugars | **0g** |
| **Protein** | **24g** |

| | |
|---|---|
| Vitamin A 0% | Vitamin C 0% |
| Vitamin E 0% | Calcium 0% |
| Iron 15% | Thiamin 0% |
| Niacin 0% | Folate 0% |
| Vitamin $B_{12}$ 0% | Zinc 0% |
| Magnesium 0% | |

## 93% Lean Ground Turkey

**Nutrition Facts**

| | |
|---|---|
| **Serving Size** | **4 oz** |
| **Calories** | **150** |
| **Total Fat** | **8g** |
| **Sodium** | **95mg** |
| **Total Carbohydrates** | **0g** |
| Dietary Fiber | **0g** |
| Sugars | **0g** |
| **Protein** | **22g** |

| | |
|---|---|
| Vitamin A 0% | Vitamin C 0% |
| Vitamin E 0% | Calcium 0% |
| Iron 8% | Thiamin 0% |
| Niacin 0% | Folate 0% |
| Vitamin $B_{12}$ 0% | Zinc 0% |
| Magnesium 0% | |

## 73% Ground Beef

**Nutrition Facts**

| | |
|---|---|
| **Serving Size** | **4 oz** |
| **Calories** | **350** |
| **Total Fat** | **31g** |
| **Sodium** | **70mg** |
| **Total Carbohydrates** | **0g** |
| Dietary Fiber | **0g** |
| Sugars | **0g** |
| **Protein** | **18g** |

| | |
|---|---|
| Vitamin A 0% | Vitamin C 0% |
| Vitamin E 0% | Calcium 0% |
| Iron 10% | Thiamin 0% |
| Niacin 0% | Folate 0% |
| Vitamin $B_{12}$ 0% | Zinc 0% |
| Magnesium 0% | |

# Investigating Your Health:
# Extraordinary Eggs

**STUDENT HEALTH INVESTIGATION**

## Lesson Focus

Explore the nutritional composition and health benefits of eggs.

## Lesson Description

Students will compare and contrast the nutritional information of white eggs and brown eggs. They will also compare the nutritional components obtained from the egg white and the egg yolk.

## Academic Content Standards

**ELA Common Core Standards for Literacy in Science and Technical Subjects (R-reading, W-writing, SL-speaking and listening, L-language) Grades 6-8**

**R-1** Cite specific textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

**R-4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical content relevant to grade (6-8) text and topics.

**R-10** Read and comprehend science/technical texts in the grades 6-8 text.

**W-2** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

**W-7** Conduct short research projects to answer a question (including a self-generated question) drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

**W-9** Draw evidence from informational texts to support analysis, reflection, and research.

## Next Generation Science Standards

### Performance Expectations

**MS-LS1-7** Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.

## Disciplinary Core Idea

**LS1.C** Organization for Matter and Energy Flow in Organisms: Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, support growth, or release energy.

## Science and Engineering Practices

**Analyzing and Interpreting Data:** Analyze and interpret data to determine similarities and differences in the findings.

# Suggested Instructional Plan

1. Instruct students to research eggs and their health and/or nutritional benefits prior to beginning the investigation.

2. Using the provided student background or information learned from researching eggs, students should examine the nutrition profile for brown and white eggs and egg whites and egg yolks.

3. Students can find the nutrition profile of eggs by accessing the USDA's nutrient database (http://ndb.nal.usda.gov/ndb/search/list), or by using the labels provided.

4. If you choose to use the provided egg nutrition information, see the Teacher Edition workbook for answers to the Investigating Your Health lab questions. Answers to questions should be similar despite the food label source used.

5. If completed in-class, allow students to work in small groups on the Investigation worksheet to further explore the topic and respond to questions.

6. Follow-up with a class discussion about student findings related to the health benefits of eggs.

# Egg Food Labels

| | White Egg | Brown Egg |
|---|---|---|
| Serving Size | 1 large egg | 1 large egg |
| Calories | 70 | 70 |
| Total Fat | 5g | 4.5g |
| Saturated Fat | 1.5g | 1.5g |
| Cholesterol | 185mg | 215mg |
| Sodium | 70mg | 65mg |
| Protein | 6g | 6g |
| Calcium | 2% | 2% |
| Vitamin A | 6% | 6% |
| Iron | 4% | 4% |

| | Egg White | Egg Yolk |
|---|---|---|
| Calories | 17 | 55 |
| Total Fat | 0 | 4.5g |
| Saturated Fat | 0 | 1.6g |
| Cholesterol | 0 | 184mg |
| Sodium | 55mg | 8mg |
| Protein | 3.6g | 2.7g |
| Folate | 1mcg | 25mcg |
| Vitamin D | 0 | 37 IU |
| Vitamin A | 0 | 245 IU |
| Phosphorus | 5mg | 66mg |
| Iron | 0.03mg | 0.46mg |
| Calcium | 2mg | 22mg |
| Potassium | 54mg | 19mg |
| Magnesium | 4mg | 1mg |